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SUPPLEMENT

METHODOLOGY FOR ANALYSIS OF FBM FIRE CONTROL AND MISSILE SYSTEM TRAINING

Contract NOp-1351

Prepared by

DUNLAP AND ASSOCIATES, INC.
Washington, D. C.

for the

NEW DEVELOPMENTS RESEARCH BRANCH
PERSONNEL RESEARCH DIVISION
BUREAU OF NAVAL PERSONNEL

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PERSONNEL RESEARCH MEMORANDUM

Although personnel research memoranda in the area of new weapons and support systems contain the best available preliminary information, some revisions may be required as the technical development of the systems progresses.

The conclusions and recommendations advanced are for information purposes. Policy considerations as well as planning factors are applied prior to implementation. Therefore, these are not to be considered official policy or to indicate final course of action by the Bureau of Naval Personnel.

ACKNOWLEDGMENTS

This study was performed under the auspices of CAPT R. J. Baxter, USN, Director of the Personnel Research Division, Bureau of Naval Personnel. The work was implemented through the Personnel Research Division's New Developments Research Department under its head, Mr. A. A. Sjoholm. Specific direction and monitorship of the project was assigned to and carried out under the cognizance of the Special Systems Group. The Group Director was Mr. J. A. Kinney, with contract monitorship and technical liaison carried out by Mr. Kinney and by Mr. R. A. Madle.

We wish to express our thanks to CDR C. H. Cushman, FBM Director for the Guided Missiles School, LT J. L. deGroff, in charge of training for the FBM Weapon System, LT V. W. Bacon, in charge of 598/608 class training, LTJG W. Ashley, in charge of 616 class training, LT P. R. Fournier, in charge of Special Technology training, and other officers and instructors at the Guided Missiles School who cooperated in the conduct of this study.

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Appendix B of this report lists many other personnel who contributed to this research effort.

This research was conducted by the following staff members:

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CONTENTS

I. INTRODUCTION

A. STATEMENT OF OBJECTIVES OF THIS VOLUME

The purpose of this volume is to describe and evaluate the methods used in the analysis of the U. S. Naval Guided Missiles School's FBM Fire Control and Missile System training at Dam Neck, Virginia. This description encompasses not only those procedures that should be employed, but also those that should not. It is hoped that the experience gained in this study will prove beneficial to future research by the Chief of Naval Personnel.

B. ORGANIZATION OF THIS VOLUME

This volume is divided into four parts:

Part I - INTRODUCTION

Organization of this volume, statement of study objectives, underlying assumptions (ground rules), and end products of study.

Part II - GENERAL APPROACH

A brief account of the general procedure employed.

Part III - PROCEDURES EMPLOYED

A detailed account of the steps employed in collection, analysis, and summary of the data and preparation of recommendations.

Part IV - EVALUATION OF RESEARCH METHODOLOGY

An evaluation of limitations of this study.

Three appendices are attached: Appendix A, "Forms Employed in Study," Appendix B, "Contact List," and Appendix C, "References."

C. STATEMENT OF STUDY OBJECTIVES

1. Determine those critical skills and knowledges and the corresponding depth of training required of Polaris crewmen to effectively operate and maintain FBM Fire Control and Missile Systems;

2. Determine what is being taught at the U. S. Naval Guided Missiles School, Dam Neck, Virginia, and how it is being taught;

3. Evaluate discrepancies between (1) and (2);

4. Make specific recommendations for improvements in the Fire Control and Missile Systems training and related Special Technology training at the Guided Missiles School.

D. ASSUMPTIONS UNDERLYING STUDY (GROUND RULES)

There were a number of areas in which contractors' recommendations for improvement of training were precluded to some extent by constraints on the scope and content of the study. These constraints, or "ground rules," were imposed by the Bureau of Naval Personnel and other cognizant groups. As a result of this study, it may be desirable to change some of these constraints because of the limitations they impose upon the implementation of training recommendations. Among the more important limits are the following:

1. Proficiency Level of Dam Neck Graduates - The Guided Missiles School is required to produce technicians who are capable of standing watches and repairing equipment without supervision upon graduation.

2. Ready-for-Sea (RFS) Ship Dates - RFS ship dates are firm advance requirements which may not be tampered with.

3. Evaluation of Instructors - The contractor is not to evaluate instructors or instructor variables.

4. Funds Available to Improve the Training Environment - Present planning for classroom and laboratory space, and training equipment, especially operational equipment for training purposes, are relatively fixed.

5. Changes to Operational Equipment - Design changes to operational equipment are not to be considered.

6. Student Population - No changes to training curriculum are permitted which require the raising of entrance requirements which, in turn, reduce the number of potential/available entrants from the Navy's manpower pool.

7. Jurisdictional Constraints - Recommendations outside the jurisdictional limits of the Bureau of Naval Personnel are not to be considered; e. g., recommendations encroaching on fleet or ship training prerogatives. In a few cases, recommendations falling outside these jurisdictional limits were felt to have significant impact on the purposes of this study and are submitted, although beyond the original scope of this study.

E. END PRODUCTS OF STUDY

1. List of Reports

The results of this study are contained in three volumes:

Vol. I	-	An Analysis of FBM Missile System Training
Vol. II	-	An Analysis of FBM Fire Control System Training
Supplement	-	Methodology for Analysis of FBM Fire Control and Missile System Training

2. Raw Data

All raw data collected during the study (course attendance forms, questionnaires, observer's notes, etc.) were forwarded to the Bureau of Naval Personnel at the completion of the study.

3. Trouble Failure Report (TFR) Data Presentation

Trouble and Failure Report data from FBM submarines on patrol were analyzed and are presented in Volumes I and II.

II. GENERAL METHOD OF DATA COLLECTION

This project was originally organized into four phases of data collection: Documentation, Contractors and Facilities, Interviews, and Sea Trials. It was realized after the start of the project that it would be desirable to conduct the phases concurrently due to the short duration of the study. It was also decided to eliminate use of observers to collect sea trial data because of the inherent difficulties in obtaining reliable observations.[1]

The essential feature of the methodology employed may be termed iterative in that the end products of the study were the result of a series of successive approximations, each step based on the knowledge gained from previous steps. The main advantage of this procedure is that the procedure and recommendations are based upon information obtained during the entire project, thus assuring maximum currency, correctness and relevancy of the end products. The main disadvantage is that it is difficult to manage several on-going phases of data collection and analysis simultaneously without a certain amount of wasted effort and loss of precision in the definition of the methodology.

[1] Contractor personnel have been involved previously in several sea trial observations aboard FBM Submarines in the course of their work on Contract NOw 62-0085-c(FBM) for the Special Projects Office. These observation trips have subsequently been abandoned because of lack of correlation between operator activity on sea trials and on operational missions, and also because of poor observer conditions.

III. PROCEDURES EMPLOYED

The specific procedures employed in this study were organized to meet the objectives stated above, namely, to determine the operation and maintenance requirements; to determine methods and content of Dam Neck training; and to evaluate this training.

A. DETERMINING THE OPERATION AND MAINTENANCE REQUIREMENTS[1]

1. Determination of Level of Proficiency and Maintenance Training Requirements Imposed Upon Dam Neck

Informal interviews and document surveys were used to determine:

a. The SP-11 technical proficiency requirement philosophy for FBM training;

b. The Special Projects Office definition of submarine maintenance levels performed aboard SSB(N)s;[2]

c. The BuPers statement of missions and tasks of Dam Neck;[3]

d. The Dam Neck officer and instructor views of these requirements.

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[1] The definitions of report requirements relative to scope, content and format for recommendations were determined through meetings with BuPers, SPPE, and Dam Neck representatives. It might be noted that because this study represents a continuation of SPPE's evaluation program of FBM training, the format employed is similar to that used in: An Analysis of FBM Navigation System Training prepared for New Developments Research Branch, Personnel Research Division, Bureau of Naval Personnel, by Data Design Laboratories, Ontario, Calif. December 1961 (Confidential).

[2] SP 201 Confidential Memo No. 20-82-59 of 13 Feb 1959

[3] Pers-C2312-KF, ltr ser:C23/0648-2 of 2 April 1962

2. Determination of Skill and Knowledge Requirements

a. Methods of Data Collection

(1) Training Literature Survey - The purpose of this survey was to review research on critical skills and knowledges and corresponding proficiency standards in electronic maintenance that have been determined for comparable military systems. This review, when combined with experience gained on previous personnel research projects, was very useful in arriving at a tentative hypothesis on troubleshooting skill-and-knowledge requirements and on job standards.

(2) TFR Analysis - Trouble and Failure Report data were analyzed in order to obtain an assessment of realistic fleet maintenance skill and knowledge requirements. TFR data from September 1961 to June 1962 furnished failure information from 15 patrols of the 598 Class and one patrol of SSB(N) 608. Each equipment (all mod's combined) was listed in Appendix C of Volumes I and II as follows:

- Total number of TFRs
- Percent of total Missile or Fire Control System TFRs
- Number of TFRs that report repair time
- Average repair time in hours

Data prior to September 1961 were not requested because it was assumed to reflect nonrepresentative malfunctions which arose during the initial "debugging" of the equipment.

(3) Review of Ordnance Pamphlets (OPs), FBM Job Task Analyses, (JTAs), SPPE Personnel Research Documents, and Submarine Qualification Training Documents - Mk 80 and Mk 84 Fire Control, and 598/608 and 616 Missile System OPs were reviewed for skill and knowledge requirements.[1] Other important sources for skill and knowledge requirements were previous JTAs,[2] SPPE FBM personnel research,[3] Dunlap and Associates' Operational

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[1] NAVWEPS Op 2670, 2752, 2760, 2850, 2851, 2922, 3001 (see Ref. A 1-7 for complete citations)

[2] Lockheed Missiles and Space Division, Sunnyvale, Calif., Job Task Analysis SSB(N) 598 Class. Prepared co-operatively with Personnel Research Div., Bureau of Naval Personnel, LMSD-2657-7, Oct. 10, 1959. CONFIDENTIAL

[3] NAVPERS, Organization and Manning Study; USS LAFAYETTE SSB(N) 616. New Developments Research Branch, Bureau of Naval Personnel. April 1961. CONFIDENTIAL

Sequences, [1,2] and Submarine Qualification Training Documents.[3,4,5] Following this review, questions pertaining to skill and knowledge requirements were formulated and placed on forms for use in fleet and instructor interviews.

(4) Visits to FBM Equipment Manufacturers - At the start of the study, it was intended to visit the following equipment manufacturers to obtain skill and knowledge requirements: General Electric Ordnance Department (GEOD), Lockheed Missiles and Space Company (LMSC), and Raytheon Company. However, only GEOD was visited because it was determined from discussions with LMSC and GEOD training personnel that the other two visits were unnecessary.

(5) Fleet and Dam Neck Requirements Interviews

(a) General Approach to Interviewing - Interviewees from the fleet and from Dam Neck were given a briefing on the purpose and scope of the study and the identity and relationship of the contractor to the Navy. This briefing helped to establish rapport by placing the interviewees in the role of a military advisor to a civilian research group. Interviewees were assured of confidential treatment of their responses. The interviewers used the following outline:

I. Purpose

A. Dunlap and Associates, Inc. has been designated by the Bureau of Naval Personnel to determine the knowledge and skill requirements for operation and maintenance of the FBM Weapon System in the Fire Control, Missile, and Guidance areas.

[1] Operational Procedure and Decision Diagram for the Fleet Ballistic Missile System. Dunlap & Associates, Inc. Memorandum Rept. No. 27. Feb. 1959

[2] Operator Sequence SSB(N) 616, Normal Tactical Submerged Mode. Dunlap & Associates, Inc. Memorandum Rept. No. 44. Feb. 1962

[3] USS A. HAMILTON Weapons Department Instruction 1500.1. Weapons Department Precommissioning Training. Sept. 1962

[4] USS A. HAMILTON Instruction 1510.1. Requirements for Submarine Qualification. Sept. 1962

[5] USS LAFAYETTE Weapons Department Instruction 5400.1. Weapons Department Organization and Regulation Manual. Nov. 1962

II. All replies will be treated confidentially.

III. Give Schedule to respondant and have him fill out biographical data.

IV. Go over instructions on checklist and administer.

V. Open-ended interview.

With few exceptions, all interviewing was conducted on an individual basis. Where interviewing was done on a group basis, interviewees personally recorded their own responses. The group interview was later avoided; early trials with the interview schedule showed that group interviewing resulted in fewer and less complete responses. Individual interviews also permitted the interviewer to alleviate hesitancy or confusion on the part of interviewees.

By design, the interview was semi-structured.[1] Questions were written and questionnaire forms prepared prior to the interviews. However, since all interviewees were thoroughly familiar with the aims of the questionnaires, rigid adherence to prepared wording was not required. Throughout the interview, the interviewer solicited comments.

i. New London Interviews - Formal and informal interviews were conducted with off-duty fleet Weapons Officers, Assistant Weapons Officers, MT and FT supervisors and recent Dam Neck MT and FT graduates.

Informal interviews were also conducted with SubRon 14 and 16 Training Officers and New London Refresher Training Officers.

With respect to sampling, the goal was to obtain interviews with two Dam Neck graduate FTs, one FT supervisor, two Dam Neck graduate MTs, one MT supervisor, an Assistant Weapons Officer, and a Weapons Officer from each ship of the 598 and 608 classes with operational experience. For the 610, 616, and 617 SSB(N)s which were not operational

[1] Lindzey, Gardner (Ed.) Handbook of Social Psychology. Vol. I, Cambridge, Mass.: Addison-Wesley Co., 1954, pp 449-487

at the time the study was conducted, the same sampling design was used. In general, the objective of representative sampling was achieved. Table I summarizes the fleet interviews that were obtained. Departures from sampling objectives are explained in the footnotes to the table.

ii. Dam Neck Interviews - Formal and informal interviews were conducted with Special Technology and hardware course instructors. Table II tabulates the breakdown of these interviews. A total of 62 instructor interviews was obtained.

(b) Interview Forms Employed

i. Initial Fleet Interview Form - The form developed for initial fleet interviews (Form IFI) is presented in Appendix A. It is divided into six parts. Part I of this form is devoted to biographical information about the interviewee; Parts II - III concern rating instructions, special skill and knowledge factors, basic skill and knowledge requirements for FTs, and basic skill and knowledge requirements for MTs; Parts IV, V, and VI concern, respectively, test equipment requirements, level of maintenance performed, and general questions.

Part I - Biographical Background - The biographical factors of age, training, experience and paygrade were used to assess the value of interviewee comments.

Parts II and III - Special and Basic Skill and Knowledge Requirements Schedules - Each interviewee was requested to rate, on the basis of his knowledge of fleet requirements, the degree and type of knowledge needed to operate and maintain Fire Control and Missile System equipment. (Slight procedural variations on this and other forms have been foot-noted on the applicable forms.)

TABLE I

Interviews Obtained from FBM Fleet Personnel*

	Mk 80 and GS (1)							Mk 84 & GS(2)			
SSB(N)	598	599	600	601	602	610	Total	616	617	Total	Grand Total
MT Trainee		2	3	4	2	4	15	3	2	5	20
MT Supv.	1	6	3	7	1	1	19		1	1	20
FT Trainee	2	3	1			2	8	3	2	5	13
FT Supv.	3	1	1	2			7	1	1	2	9
WO	1	1	1	1			4	1	1	2	6
AWO	1	2		1	1	1	6	1	1	2	8
	8	15	9	15	4	8	59	9	8	17	76

* Unfilled spaces were a result of the following conditions:

(1) personnel were on travel from New London during each of the three staff visits to the Submarine Base.

(2) personnel who were recent graduates of Dam Neck FBM training were not assigned to the particular ship.

(3) personnel duties at the Submarine Base or Electric Boat Division prevented interviewing during staff visits.

Personnel from SSB(N)s 610, 616, and 617 did not have patrol experience at the time of staff visits.

TABLE II

Instructors Interviewed at the Guided Missile School

	80 FT 598/608 MT	84 FT 616 MT	
Four-week Systems Course	3	4	
FT Maintenance Course	10	19	
MT Maintenance Course	11	7	
	24	30	
Total interviews for "hardware" courses			54
Special Technology Course			8
TOTAL			62

Part IV - Test Equipment Requirements Schedule - Interviewees were presented with a list of test equipment used for testing the Fire Control and Missile System equipments. On the basis of what they did in their present assignment, they were asked to place a check mark in the appropriate column if they: (a) repaired the equipment, or (b) used the equipment in preventive and/or corrective maintenance.

Part V - Level of Maintenance Performed Schedule - Equipment lists were presented and interviewees were asked to check in the appropriate column the level of corrective maintenance that was performed. The three levels of maintenance were: assembly replacement, module replacement, and piece-part replacement.

Part VI - General Interview Questions - A series of open-ended questions was asked to solicit general comments.

ii. Final Fleet Interviews - The form developed for final fleet interviews (Form FFI) is included in Appendix A. It was used for subsequent trips to New London following the initial determination of requirements. Several new questions relating to fleet requirements and practices were substituted for Part VI, "General Interview Questions" in Form IFI. In addition, the checklist procedure previously employed was modified to allow intensive questioning on each individual skill and knowledge requirement. The new questions that replace Part VI, Form IFI, are described below. A discussion and listing of the questions used in the modification of the checklist procedure is presented in Section C, "Evaluation Procedures."

Duty Description - Both supervisors and trainees were requested to describe in detail the task performed and the equipment operated and/or maintained during a typical watch.

Weapons Department Organization - Weapons Officers were asked to describe how the weapons department was organized on their particular ships.

Training and Assignment Practice - Recent FT and MT Dam Neck graduates were asked to provide information about on-the-job training that was received in the duties normally performed by other personnel.

Officers and supervisors were asked to describe events that occur in the shipboard training of Dam Neck graduates, starting from the day they come aboard until they are permitted to stand watch independently. In addition, they were asked to discuss why operators were assigned to particular equipment. This question yielded information on the degree of specialization, i.e., whether personnel tend to specialize in the operation and maintenance of individual equipments, and how long a period of training is necessary to qualify for Missile Compartment (MC) or Missile Control Center (MCC) watch-standing.

Objective of Dam Neck Training - Officers and supervisors were asked to comment on what the objectives of Dam Neck training should be.

Depth of Maintenance Performed - Trainees and supervisors were asked to list the typical sequence of events that occurs upon observation of an equipment casualty. Information on the level of maintenance was also obtained through the use of form CSF, which was primarily used to evaluate strengths and weaknesses of recent Dam Neck graduates in the steps of troubleshooting and repair of malfunctions.

System Skills and Knowledges - Dam Neck graduates and supervisors were asked to identify malfunctions that were difficult to isolate and to discuss system skill and knowledge requirements.

iii. Initial Instructor Interview Form (I. I. I.) - This form is presented in Appendix A. It is concerned mainly with the determination of how 80 FT and 598/608 MT instructors at Dam Neck view fleet requirements. It was useful in determining disparities between fleet requirements and what Dam Neck teaches and has been more fully described in Section C, "Evaluation Procedures."

iv. Final Instructor Interview Form (FII) - This form (Appendix A) was used to determine hardware course entrance requirements imposed upon Special Technology training. For this purpose hardware course instructors were asked to identify and discuss the topics that should and should not be taught in the Special Technology courses as preparation for material covered in the hardware course. The interview format for arriving at these requirements was a checklist for each Special Technology topic by means of which instructors evaluated the adequacy of recent Special Technology graduates. A more detailed description of this procedure has been presented in Section C, "Evaluation Procedures."

3. Skill and Knowledge Requirements Recommendation

Skill and knowledge requirements for Fire Control Technician (FT) and Missile Technician (MT) were developed from the above sources and presented in Appendix A of Volumes I and II. Skills and knowledges were divided into the following three categories and prefaced by a minimum proficiency requirement intended to serve as a job standard:

a. General Skills and Knowledges - These factors are general operation and maintenance requirements since they contain elements which are transferable from system to system; e.g., troubleshooting techniques and performing well as a team member.

b. System Specific Skill and Knowledge Requirements - These factors specific to the FBM Fire Control and Missile Systems are mostly knowledge factors needed by technicians to analyze and isolate system casualties. Technicians possessing these and the general factors are capable of performing first level maintenance (i. e., system testing and module replacement).[1] Effective first level maintenance requires technicians to understand completely

[1] Op cit SP 201 Memo

the subsystem for which they are responsible and to have knowledge of the signal flow to and from the other subsystems outside of their responsibility. For this reason, three levels of FBM System understanding were differentiated:

(1) "Complete understanding of": to recognize and interpret all symptom patterns with minimum recourse to reference data.

(2) "Knowledge of": to recognize and interpret symptom patterns with the aid of reference data.

(3) "Familiarity with": to recognize that a symptom pattern exists.

c. Equipment Specific Skill and Knowledge Requirements - These factors, specific to individual equipments of FBM Fire Control and Missile Systems, are mostly knowledge factors needed by technicians to repair malfunctioning modules and repair/replace controls and indicators.

The above three categories contain the skill and knowledge factors that a technician must have by the time he graduates from Dam Neck[1] to satisfy the minimum proficiency requirement. A fourth category presents skills and knowledges that should be introduced to the technician in the Special Technology course. This latter category contains many of the skills and knowledges listed previously to indicate that an introduction should be given prior to the hardware course.

B. DATA COLLECTION ON TRAINING

This section describes how data was collected on:

What is being taught in the Fire Control and Missile Systems courses and in the Special Technology courses; and

How instruction is being carried out.

1. What is Being Taught

a. Review of training material - course outlines, lesson plans, and OPs obtained at the start of the contract served as one of two major data sources on what Dam Neck is teaching.

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[1] For that matter, this categorization would appear to be applicable to most "C" Schools which teach complex electronic or weapon systems. However, in most "C" Schools, the emphasis is usually on category 3 to the near exclusion of categories 1 and 2

b. Course attendance - this was the second major data source on what is being taught at Dam Neck. (Course attendance was, of course, also valuable for determining how material was presented, as will be pointed out below.)

From the standpoint of the requirements of this study as stated by the Bureau of Naval Personnel, it was desirable to attend as much of the Special Technology course and the systems and hardware courses as possible within the time constraints of the contract. In the proposal, the contractor specified that two weeks of course attendance would be provided with the possibility of three additional weeks if it was felt that there was need for additional information. In actuality, however, a total of nine weeks of course attendance was provided. The distribution of course attendance was as follows: five of the nine weeks were spent in Special Technology and four weeks in the systems and hardware courses. The additional time was provided by combining to some extent the activities of course attendance and course evaluation. The method of course attendance was as follows: trained observers with an average length of prior experience in the Polaris program of 2-1/2 years were employed in FT and MT course attendance. For Special Technology and a portion of the hardware course attendance, a former Navy Electronics Technician, who is now a trained psychologist, was employed. This provided a trained observer with an "A" School background who could evaluate the particular learning processes required for Special Technology and hardware course material in addition to experienced engineers who evaluated course content.

The general procedure followed was to switch to a different class every period except when it was desirable to observe a particular class in action for more than one period. Inasmuch as a number of sections of many courses were offered either concurrently or sequentially for different classes, a wide sampling of instructors and students for the same course content was obtained. It should be pointed out that it proved valuable, especially initially, to have two or more staff members attend the same class session in order to provide an indication of the reliability and validity of the observations, in addition to clearing up possible ambiguities in the observer's schedule.

In course attendance, the principal form employed was the Course Observer's Form (COF) which consisted of the Observer's Course Analysis Schedule, the Training Equipment Checklist, and the Critical Skills Schedule (see Appendix A). The Observer's Course Analysis Schedule was used for observations in four categories: teaching aid utilization; laboratory performance; student participation and understanding; and observations of significant incidents. The Training Equipment Checklist was also used in the general survey of training equipment, and the Critical Skills Schedule was used to record observations of students' performance during laboratory periods.

2. How Instruction is Being Accomplished

a. Review of course organization, sequencing, and time allocation - The principal data sources for information on this topic were: (1) Interviews with Curriculum Development Branch, Bureau of Naval Personnel for information on the history of FBM training, contracts for the development of training materials, curriculum standards and time sequencing and allocation; and (2) interviews with Dam Neck instructors and officers during which course schedules were reviewed.

b. Observation of Instruction Methods - Although the evaluation of instructors and instructional variables was not specifically studied, valuable information was obtained during course attendance on the following: the degree to which instructors emphasized system relationships; instructor-student interactions, individual and team operation and maintenance training, and instructor utilization of the concepts and principles of learning.

c. Uses of Training Equipment - Training equipment at Dam Neck was categorized as: training aids; training devices; simulators; or tactical equipment in a training capacity. The primary data sources for determining how training equipment helps to implement training were:

(1) Observation of actual equipment - A part of the early Course Observer Forms (see Appendix A) was devoted to recording observations of training aid utility according to the following criteria: Training aid augments, clarifies, and emphasizes the verbal instructions by being properly scaled and dimensioned; simply designed for interpretability and use; visually accessible; artificially color coded for emphasis.

This procedure was changed to a checklist method which was more inclusive and applicable to both course attendance and general surveying of training equipment. This checklist is presented in Appendix A. It was modified after Edgerton et al. [1]

(2) Interviews with BuPers representatives - regarding present and planned training equipment.

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[1] Edgerton, Harold A., Feinberg, Mortimer R., Korolow, Norman; and O'Malley, Thomas, How to Get More out of Training Aids. Special Services Center, Technical Report SDC 383-7-1

(3) Instructor interview questions (Form FII):

(a) What training equipment do you use in presenting your subject matter, such as: display boards, charts, mock-ups, projection systems, simulators and actual equipment?

(b) Identify any training equipment not presently employed that would be helpful to you.

(c) Identify any training equipment now available to you which could be improved.

d. Observation of Training Environment - The data sources for information on the training environment at Dam Neck consisted primarily of inspection of classrooms, buildings, base facilities, and interviews with officers, instructors, graduates and students.

C. EVALUATION PROCEDURES

This section is concerned with the procedures used to: compare fleet requirements with what Dam Neck is teaching; compare hardware course entrance requirements with what the Special Technology course is teaching; and formulate training improvement recommendations in the hardware and Special Technology courses. In addition, the methods used in evaluating training equipment and training environment are presented.

1. Comparison of Fleet Requirements with what is Being Taught in the Hardware Course

a. Instructor's views of fleet requirements - One of the methods used for comparison of fleet requirements with what Dam Neck is teaching was to contrast requirements information obtained in fleet interviews with Dam Neck instructors' views of these requirements. To accomplish this purpose, Form IFI was modified for use at Dam Neck. Four senior instructors (2 80FT and 2 598/608 MT) were requested to rate skills and knowledges in terms of what the average MT or FT "needs" and "gets" (Form III, Appendix A). Summary comparisons of fleet and Dam Neck's views revealed areas in which there were both substantial agreement and disagreement.

b. Fleet evaluation of recent Dam Neck graduates - A major source of field data for the comparison of fleet requirements with what Dam Neck teaches were the fleet interviews conducted with Form FFI. With this form,

fleet supervisors were asked to evaluate recent Dam Neck graduates by means of a series of questions on each FT and MT skill or knowledge. (These questions were also asked of recent Dam Neck graduates to provide a secondary data source in the evaluation.) These instructions were given to the interviewee:

> Trainees have received intensive instruction in each of the following areas. Evaluate your/his proficiency in these areas prior to shipboard on-the-job training and experience. Use the following criterion:
>
> HAD AN ADEQUATE THEORETICAL AND PRACTICAL KNOWLEDGE OF THIS AREA PRIOR TO ANY SHIPBOARD TRAINING OR EXPERIENCE
>
> If you feel that you are not qualified to evaluate proficiency place a check mark in the (?) space.

Supervisors and trainees were then asked the following questions for each skill and knowledge (FTs were given lists of FT skills and knowledges and MTs were given lists of MT skills and knowledges):

1. Has criterion been met? Yes___; No___; (?)___. No training or experience required___.

2. If criterion has been met, could less time have been spent on this topic at Dam Neck? Yes___; No___; (?)___. If yes, should less time be spent on: primarily practical___, primarily theoretical___, both practical and theoretical___training?

3. If more training is required to meet criterion, what effect does this lack of training have on the performance of specific tasks?

4. To overcome this weakness, should additional Dam Neck training be: primarily practical___, primarily theoretical___, both practical and theoretical___?

5. Was additional introductory-type training on this topic provided after Dam Neck? Yes___; No___. If yes, indicate whether it included any of the following: special lectures___, practical demonstrations___, homework or problem assignments___. How many additional hours were provided?

6. Comments

Following the completion of this part of the interview, supervisors were asked to rate Dam Neck graduates on critical skill and knowledge proficiency (see Schedule CSF, Form FFI, Appendix A). Following the completion of this schedule, supervisors were asked two specific questions (see Questions 3 and 4, Schedule SQ, Form FFI, Appendix A). In terms of fleet requirements, what, if any, are the most significant deficiencies/strengths in trainees coming from Dam Neck? What, in your opinion, should be the objective of Dam Neck training?

c. Contractor's evaluation and recommendation procedure - The main results of the contractor's evaluation and recommendation procedure are reflected in proposed course outlines for FT and MT training at Dam Neck. In developing the course outlines the detailed skill and knowledge list was used as the major criterion for assessing adequacy of content and depth of courses. This criterion was supplemented by the contractor's analysis of all fleet and Dam Neck interview data and TFR data where applicable. Current training theory and accepted techniques for applying training theory to technical training were used as criteria for curriculum organization.

The present outlines for each of the major subdivisions of the courses under investigation were reviewed early in the project. Adequacy of content, method, and depth of presentation of current course material was determined through an analysis of the data collected on training described in section B according to the following standards:

- System relationship - the degree to which training materials taught the system concept.
- Accuracy of information - the degree to which training material is complete, timely, and accurate.
- Level of detail - the degree to which the training was above or below the training level required by the fleet, e.g., the training objective was not to produce graduate engineers.
- Difficult areas in the materials - specifically, those training areas which were difficult to grasp due to the complexity or highly abstract nature of the subject matter.
- Concepts and principles of learning - the degree to which the courses met the requirements of human learning.

Estimates of the adequacy of presented material were derived from:[1]

- Comparison of course materials depth and scope with skill and knowledge criteria (EA).[2]
- Fleet interview data on the adequacy of recent Dam Neck graduates (FC).
- Comparison of methods, emphasis, and order of presentation with training methodology standards and criteria the contractor employed (D&A).
- Course observation samples by training specialists and engineers (CO).
- Analysis of the ratio of equipment complexity and criticality of system function to the amount of time spent on training (C).

Where appropriate, these estimates of adequacy were used as justifications for recommended changes in the course outlines. Major recommendations affecting overall philosophy of instruction, course structure or scheduling are spelled out in detail with their justifications in the body of the report. Recommendations affecting the general emphasis or depth of coverage for an entire course subdivision (e.g., Special Technology) are summarized in the introductory pages of Appendix B in the appropriate volume. Figure 1 shows a sample page from course outline recommendations for the 84 FT course.

Justifications for repetitive recommendations or major additions to the course outline are also included in the introductory pages. The recommendations themselves are presented in detail in the course outline the first time an appropriate topic appears. Subsequent appearances are referenced to the first appearance.

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[1] Miscellaneous data sources that contributed to this and subsequent aspects of the evaluation procedure were trainee critique forms, SubRon 14 and 16 Training Officers' comments and New London Team Trainer instructors' comments.

[2] In Volumes I and II, Appendix B, the recommendations are coded (EA, D&A, etc.) according to the evaluative source.

SAMPLE

84 FT
FCS Maintenance

Week 23

Topic	Recommendation	Justification	Periods Present/ Proposed
1. System operation, TAC	Transfer and increase. Provide additional operational training.	FC	0/7
2. Laboratory	Provide additional malfunction analysis practice.	FC[1]	25
3. Examination			3

[1]Note: Justifications for specific recommendations within the course are coded as follows:

EA	Engineering Analysis
LP	Lesson Plan Analysis
TA	Training Aid Analysis
TFR	Trouble and Failure Report Analysis
C	Criticality of system, subsystem or component
D&A	Learning Theory
FC	Fleet Comments

Figure 1 - Course Outline Recommendation Format Employed

SAMPLE

2. Comparison of Hardware Course Requirements with what the Special Technology Course Teaches

a. Hardware course instructors' evaluation of Special Technology graduates - The same procedure employed in interviewing fleet supervisors on the adequacy of Dam Neck hardware training was used in interviewing hardware course instructors on the adequacy of Special Technology training. Hardware course instructors were asked to evaluate student proficiency in the content taught at the Special Technology Course and considered prerequisite to entry to the hardware course.

b. Contractor's evaluation and recommendation procedure - A procedure nearly identical to that employed in the contractor's evaluation and recommendation procedure for Dam Neck hardware courses was employed.

3. Evaluation of Training Equipment

Training equipment at Dam Neck was evaluated to determine the present and future needs for training equipment.

a. Definitions - To establish a common basis for the study, Dam Neck training equipment was categorized as: (1) training aids; (2) training devices; (3) simulators; or (4) tactical equipment in a training capacity. At the start of the project, it was realized that definitions of these equipment categories would be helpful in establishing a basis for analysis of present and proposed Dam Neck equipment. Inasmuch as standard definitions have not been adopted by the Navy, the following definitions were developed. (Documents used to develop these definitions included: USAF document, Development of Training Equipment Planning Information;[1] USNTDC standards; and visits with representatives of ONR and the Training Aid Division of BuPers.)

(1) Training Aid - An item of equipment, usually instructor-operated, which facilitates instructions by visual or auditory means and demonstrates the functional physical characteristics of a tactical item. It may be either static or dynamic.

[1] Demaree, Robert G., Development of Training Equipment Planning Information. Aeronautical Systems Division, Air Force Systems Command, U.S. Air Force, Wright Patterson Air Force Base, Ohio. ASD Technical Report 61-533, (ASTIA AD-267 326), October 1961, p. 16.

(2) Training Device - An item of equipment, usually trainee-operated, which performs one or more specific functions by synthetic means or actual system parts. This thereby exercises trainee skills.

(3) Simulator - A relatively complex item of equipment, usually trainee-operated, which physically, functionally, and temporally reproduces the necessary operational conditions to exercise trainees in their operational mission.

(4) Tactical Equipment - Operational fleet equipment, generally furnished to reproduce the necessary operational conditions for trainee practice.

b. Training equipment purpose (TEP) table - Each item of training equipment was placed in a training equipment category according to the degree its training purpose matched one of the training purposes in Table III.

c. Recommendations - In Volumes II and III, recommendations for training equipment to overcome weaknesses in training at Dam Neck were developed through use of the TEP Table in conjunction with a review of research studies on the use of training equipment to teach system concepts[1] and trouble-shooting skills.[2]

4. Evaluation of Training Environment

The data sources on training environment (i.e., observations of classrooms, buildings, and base facilities and interviews with officers, instructors, graduates and students on the training environment) were evaluated according to the following criterion: To what extent do weaknesses in the training environment interfere with the mission and tasks of Dam Neck? For those weaknesses identified, recommendations were made to overcome them within the constraints of the study.

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[1] Miller, Robert B., Task and Part-Task Trainers and Training. American Institute for Research, Wright Air Development Division, WADD Technical Report 60-469, June 1960.

[2] Shriver, E. L., Fink, C. Dennis, and Trexler, Robert C., Increasing Electronics Maintenance Proficiency through Cue-Response Analysis. Human Resources Research Office, The George Washington University.

TABLE III

TRAINING EQUIPMENT PURPOSE TABLE[1]

Training Equipment Categories / Training Purpose	Training Aids	Training Devices	Tactical Equipment (Training Capacity)	Simulators
Learning of Knowledge	1	2	2	2
Learning of Skills and Part Tasks (Maintenance)	2	1	2	2
Learning of Whole Tasks and Part Tasks (Operation)		2	1	1
Learning of Team Tasks			1	1

1 indicates primary purpose
2 indicates secondary purpose

This procedure had the advantage of:

(1) Emphasizing training purposes rather than arbitrary training equipment names

(2) Being trainee-oriented rather than instructor-oriented

(3) Assisting in the recommendation of training equipment to overcome weaknesses in training at Dam Neck

[1] op. cit., Demaree, (This table is a modification of Training Functions Table, p. 33)

IV. EVALUATION OF RESEARCH METHODOLOGY

A. INTRODUCTION

The purpose of this section is to furnish an overall review and evaluation of the procedures and underlying theory used in this research. The research was divided conceptually into four tasks: development of training requirements; determination of existing training; analysis of discrepancies between requirements and existing training; and recommendations for a revised training program.

Performance of each of these tasks is reviewed with respect to the role, or relative importance, of the task in the training development cycle; the constraints within which the research was performed; and the effects of these constraints upon the adequacy of the study.

B. STATEMENT OF TASK I

The initial task requirement for this research was to develop the training requirements. This was accomplished by integration of information about system maintenance and operation philosophies, technical details of equipment, and fleet operational experience into lists of skill and knowledge requirements for Fire Control Technician and Missile Technician ratings.

1. Role of Task I in Training Development Cycle - The role of this task was to determine operational needs not only as comprehensive lists, but also in terms of the additional skill and knowledge increments required of present FT and MT trainees in order to meet desired fleet operational requirements.

2. Constraints and Their Effects Upon Task Accomplishment

a. Since the duty requirements of men on patrol are continually changing (due, for example, to new concepts of equipment testing or increased equipment reliability), the training requirements for new men prior to their first patrol change, accordingly. Whereas the low reliability characteristic of a weapon system in its early stages implicitly places a stringent training requirement upon maintenance skills and knowledges, the high reliability of the matured system demands more training emphasis upon testing and operational skills and knowledges.

The effect of this constraint was to outdate some recommendations almost before the completion of the study. The iterative approach employed in the general procedures for data collection and analysis served to keep the recommendations up-dated.

b. Although it was desirable to use available documents listing job requirements to the maximum extent possible, an unavoidable constraint was the lack of currency of the 598/608 Job Task Analysis and the inaccuracy (understandable due to its predictive character) of the 616 Class manning document.

The effect of outdated documents was negligible because there was a large source of supplementary data available. In addition, only a few changes were required to update the material.

c. Severe time limitations imposed by the contract schedule placed unavoidable constraints upon the completeness of available fleet data. Of greatest significance was the lack of patrol experience (or even sea trial experience) of the 616 Class. In addition, for operational ships, the long interval between rotation of crews to New London resulted in some ships having only one crew represented in the fleet interview data. Despite the extremely cooperative efforts of SubRon and ship officers, the schedule requirements for refresher training or other crew duties sometimes limited crew availability at New London.

For obvious reasons, this constraint had serious effects on requirements determination, i.e., objective observations cannot be made on systems that are not operational. However, as has been shown in prior personnel research studies, accurate predictions can be made on the basis of experience with similar systems (in this case, ships in the 598 and 608 Classes) together with an engineering analysis of the particular system under study.

d. TFR data in other studies have proven to be quite variable, particularly in the accuracy of reported repair time (often confused by crewmen with down time). In other studies, significant errors have been detected in the naming of parts, categorization of failures, even in submitting a TFR. Although NOL provided a thorough compilation of available data, the dependence upon crewmen for interpretation and quantification based on a poorly designed TFR form degrades this potentially useful information. [1]

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[1] See Memo No. 52-62-36, Contract NOw 62-0085-c(FBM) (Dunlap & Assoc., Inc.)

The effect of this constraint was to limit the validity of the TFR data presented in Vols. I and II. There was no way the contractor could overcome this weakness in the study. However, the data were judged to be of sufficient value to Dam Neck to justify inclusion in the study.

e. In any interview program, even the most objective interviewers cannot overcome the bias inherent in individual responses to matters as personally important to these crewmen as was their GMS training in relation to their shipboard duties. A strenuous effort was made throughout this study to minimize the effects of these biases.

This constraint presented a serious problem: Should fleet requirements be determined by popularity polls; by responses from one or two fleet people who might be considered experts; or by some combination of these two data sources? In this study, "popularity poll"-type data were combined with expert opinion by employing a weighting system. For instance, trainee statements to the effect that, "too much time was spent on Guidance Power Supplies" would be given very little weight in relation to statements from their supervisors that, "...GMS-trained crewmen cannot adequately maintain the Guidance Power Supply units."

f. Although fleet personnel are primarily concerned with their capabilities to deal effectively with any eventualities on patrol, an inherent constraint upon fleet interview data is the very lack of objectivity that this proximity to day-to-day requirements imparts to fleet responses. Fleet interview data must be carefully evaluated in the light of the reasons for SP and SubRon maintenance, operation, manning, personnel, and other policies and not taken at face value as the final authority for what the fleet really needs from Dam Neck training.

There were a few instances where it was felt that individual ships did not have accurate knowledge of their own requirements. By sampling a number of ships, however, much of this bias was eliminated. Consistent trends were found in the responses when all ships were considered together.

g. Direct observation of crew performance on patrol was unavailable to the contractor. Moreover, previous contractor experience with the FBM Weapons System[1] indicated that weapon system trials represent atypical operations. Although the contractor was able to observe these latter operations, it was decided that they would not serve as an adequate substitute for patrol observations.

> The accuracy of the fleet requirements determination must depend on the accuracy of fleet interview data.

C. STATEMENT OF TASK II

Task II was a determination of the training program composition including the compilation of data on: (1) curriculum content and order of presentation, (2) texts and supplementary materials, (3) training aids, and (4) training time devoted to individual subjects. From these data, an estimate was made of the material being taught to the students.

1. Role of Task II - The ultimate role of this task was to furnish comprehensive knowledge of the existing state of the training program.

2. Constraints on Task II Accomplishment

a. Although effective training at Dam Neck is very dependent upon instructor attitude, ability, motivation, technique, and knowledge, the contractor was specifically instructed to avoid evaluation of these factors.

> The effects of varying instructor quality imposed an unknown effect on the classroom observation data and on the degree of learning which took place. The procedure of sampling different instructors and graduates from different classes was designed to reduce these biasing effects.

b. It might have been desirable, according to one viewpoint, for contractor personnel to follow a single class from Special Technology entrance to job performance in the fleet. However, the practical necessities of the

[1] Contract NOw 62-0085-c(FBM) (Dunlap & Assoc., Inc.)

contract schedule limited data gathering to a 12-week period, while the courses lasted up to 39 weeks. A sampling process of attendance was used, therefore, in which selected periods were attended from all ongoing courses at different times.

> While this constraint limited the contractor's ability to completely determine "what" and "how" training is being conducted at Dam Neck, course attendance was just one of many data sources which included OPs, lesson plans, training aids, trainee workbooks, etc.

c. Partially due to continual revision by Dam Neck instructors, complete sets of lesson plans for most courses were unavailable, or were already outdated when received.

> This constraint prevented a complete determination of the depth, scope, emphasis, and organization of courses. However, information gaps were filled from instructor interview data and from course observation. From these data, an adequate estimate could be made of total subject coverage and course adequacy in meeting fleet requirements.

d. In Special Technology, a shift from Naval to civilian instructors was in process during the data gathering phase of this study. This resulted in contractor observers encountering the abnormal situation of civilian instructors teaching the course for the first time.

> This constraint had negligible effect since complete lesson plans were available as the main source of data on organization, coverage, level and scope of subject matter for Special Technology. (See also C. 2. a. above.)

D. STATEMENT OF TASK III

Task III was comprised of determination of discrepancies between the existing training (i. e., what is being taught at Dam Neck) and the fleet requirements (i. e., the skills and knowledges demanded of FBM Fire Control and Missile Control Technicians in the fleet).

1. Role of Task III - The role of this task was to determine areas of over- and under-training, not only in terms of content of the training, but also in terms of levels of performance obtained.

2. Constraints on Task III Accomplishment

a. Evaluation of what was accomplished in Dam Neck training had to be modified by what was practical to accomplish. The schedule of delivery of tactical equipment to Dam Neck has always been such that some trainees are sent to the fleet with little or no practical experience on tactical equipment.

> Fleet comments reflected shortages of tactical equipment at Dam Neck. These comments were disregarded in the evaluation where it was determined that equipment deficiencies were being overcome as soon as the various demands for tactical equipment would allow.

b. In research such as this, it is unavoidable that the researchers themselves develop and apply to their recommendations some bias based on their impressions and past experiences.

> The effects of this constraint have not been assessed. An attempt was made to nullify contractor bias by utilizing cross-checks of data and review of all material by several project personnel with diversified backgrounds. Where there were differences between research conclusions drawn by project scientists, recommendations were withheld until additional information was obtained.

E. STATEMENT OF TASK IV

The recommendations for changes in the training program were generated from the analysis of discrepancies uncovered in Task III and determination of the optimum means within the scope of available facilities to overcome these discrepancies.

1. Role of Task IV - This task represented the culmination of the study in terms of final recommendations which could be implemented within the existing training structure.

2. Constraints on Task IV Accomplishment[1]

a. RFS ship dates are firm advance requirements which may not be tampered with.

> Training goals which, from a purely training standpoint, could be most easily met by extending the course duration, had to be met through other means.

b. The BuPers policy is that GMS is required to produce technicians who are capable of standing watches and repairing equipment without supervision upon graduation.

> At the outset of this research, it was realized that this goal was unattainable. This constraint was also untestable since no fleet officer would allow a trainee, regardless of qualifications, to stand initial watches unmonitored. In effect, this constraint was ignored and interpreted to mean "minimum" supervision.

c. Present planning for classroom and laboratory space and training equipment, especially tactical equipment for training purposes, is relatively fixed.

> This constraint limited the recommendations for course change in those areas which would require more space or equipment than is presently planned.

d. Design changes to tactical equipment are not to be considered.

> The most undesirable effect of this constraint from the training standpoint is that most tactical equipment assigned to Dam Neck cannot be modified to suit special training purposes. Recommendations for modifications to tactical equipment to increase their training value were, therefore, avoided.

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[1]The first six of these constraints have been listed in the Introduction to this Volume in Section I. D., but are repeated here for completeness of the discussion on the effects of constraints upon this research.

e. No changes to training curriculum are permitted which require the raising of entrance requirements into the Guided Missiles School's program if such changes will reduce the number of FT and MT graduates from the school.

> Recommendations were not considered which would significantly increase course difficulty.

f. Recommendations outside the jurisdictional limits of BuPers are not to be considered (e.g., fleet or ship training prerogatives, Dam Neck administrative support).

> This constraint was ignored in situations where it was considered that significant detrimental effects upon GMS training effectiveness were involved; e.g., Dam Neck trainee morale.

g. Class size is relatively fixed by fleet requirements and trainee availability.

> This constraint was one limiting factor in the assignment of laboratory sessions and other classes where it would be more efficient to utilize small groups.

APPENDIX A

FORMS EMPLOYED IN STUDY

INITIAL FLEET INTERVIEW

FORM IFI

FORM IFI
SERIAL _____

FLEET INTERVIEW SCHEDULE

Conducted By
Dunlap and Associates, Inc.
425 13th Street, N. W.
Washington 4, D. C.

Part I - BACKGROUND INFORMATION

Name _____ Rate _____ Age ____ Length of time in Service _____/_____ yrs. mos.

Ship _____ Crew: Blue _____ Gold _____

CIVILIAN TRAINING AND EXPERIENCE

Training: (Circle level attained)

High School 1 2 3 4; College 1 2 3 4

Civilian Technical School (Enter months studied after each topic)

a. _____ ( )
b. _____ ( )
c. _____ ( )

Related Civilian Experience: (Enter months' experience in parentheses after each job)

a. _____ ( )
b. _____ ( )
c. _____ ( )

MILITARY TRAINING AND EXPERIENCE

Training: (Enter length of school in parentheses)

"A" School ( ) "B" School ( ) "C" School - FBM ( )

Factory School - FBM ( ) Team Training (NL) ( ) Other _____ ( )
type

Experience:

Other Systems and/or other related experience: (Enter months' experience in parentheses provided)

Type _____ ( ) Type _____ ( )

Type _____ ( ) Type _____ ( )

(Cont'd. -- FLEET INTERVIEW SCHEDULE
Part I - BACKGROUND INFORMATION)

Experience:

Job assignments (e. g. while in Polaris Program): (Chronological order)

Assignment	Months	Where training was received (percent) School	On Job
1. _____	( )	( )	( )
2. _____	( )	( )	( )
3. _____	( )	( )	( )
4. _____	( )	( )	( )

FORM IFI
SERIAL _____

FLEET INTERVIEW SCHEDULE
PART II - OPERATOR'S INSTRUCTIONS FOR RATING SPECIAL SKILLS AND KNOWLEDGES, AND BASIC PROFICIENCY CATEGORIES

Conducted by
Dunlap and Associates, Inc.
425 13th Street, N. W.
Washington 4, D.C.

From your knowledge of the requirements for your assigned job, rate each listed category according to the following scale. Add any topics not included. If you have additional comments, place an asterisk(*) after your rating and make comments below. Enter the number of the appropriate rating in the columns next to the topic being rated.

0 Both practical and theoretical knowledge of this area are nice to know, but not needed to perform duties.

1[1] Thorough practical knowledge of this area needed -- theory is not required.

2[1] Thorough theoretical knowledge and general practical familiarization needed.

3 Thorough practical and theoretical knowledge needed.

The following example shows the way the rating scale is applied:

NOMENCLATURE	OPERATION	PREVENTIVE MAINTENANCE [2]	CORRECTIVE MAINTENANCE
Topic X	1	1	3

THIS IS NOT A TEST. PLEASE TAKE YOUR TIME AND RATE THE ITEMS CAREFULLY. YOUR RATINGS MAY HAVE AN EFFECT ON THE TRAINING OF FUTURE TECHNICIANS.

[1] These items were revised following initial tryout of this schedule:
1. Primarily practical knowledge of this area needed
2. Primarily theoretical knowledge of this area needed

[2] This column was deleted after the first few interviews.

FORM IFI
SERIAL

PART III-A - SPECIAL KNOWLEDGE REQUIREMENTS

	Operate	Preventive Maintenance	Corrective Maintenance
TRANSISTORS			
1. Semi-conductors			
2. H parameters			
3. Transistor biasing			
4. Common transistor circuits			

PRINTED CIRCUITS			
1. Mfg. of printed circuit boards			
DIGITAL COMPUTING			
1. Numbering systems			
2. Binary math processes			
3. Conversion between numbering systems			
4. Boolean algebra and basic laws of logic			
5. Veitch diagram			
6. Logic diagrams (functional)			
7. Switching circuits			
8. Timing circuits			
9. Shift registers			
10. Adders and subtractors			
11. Computer control circuits			
12. Jump shift circuits			
13. Magnetic theory			
a. Magnetic amplifiers			
b. Magnetic cores (in computer memory)			
14. Resolvers			
a. Inductosyns (pick-off devices)			
b. Multi-speed loop converters			
15. Integrators, differentiators and operational amplifiers			
16. Storage devices			

	Operate	Preventive Maintenance	Corrective Maintenance
17. Drum-type computer			
18. Programming			
19. Analog-digital converters			
20. Digital-analog converters			
INERTIAL PHYSICS			
1. Corioles' Effect			
2. Newton's Laws			
3. Vector analysis: forces, displacement, velocity, acceleration			
4. Gyro's			
a. Precession			
b. Torque			
5. Accelerometers			
SERVO-LOOP FUNDAMENTALS			
1. Operation and application of servo-mechanisms			
2. Schular tuned loops			
3. 3 & 4 Gimbal systems			
MISCELLANEOUS			
1. Comparators			
2. Differentiators			
3. Two-wire encoder			

COMMENTS

FORM IFI
SERIAL

PART III-B - BASIC PROFICIENCY REQUIREMENTS FOR FT's

	Operate	Preventive Maintenance	Corrective Maintenance
1. Mk 80 FCS Panels			
2. Mk 80 FCS Display Panels			
3. F/C Terminology			
4. 800-Cycle Reference Generator			
5. Digital Erase and Read-In (erase Gen. in E. U.)			
6. Timing relationship between F. C. and Guidance Computer			
7. Analog Computations			
8. Servo Module			
9. Torque Amplifier			
10. Earth's Rate Frequency Generator			
11. Digital to Analog Converter			
12. Reverse Counter			
13. Guidance Power Supply Mk 115 Mod 1			
14. Middle and Outer Gimbal Drive			
15. Decoding and Pulse Selection (PIGA decode)			
16. Events Counter Operation			
17. Timing - Interval Indicator			
18. Missile F/C Tests			
a. Missile Clock Test			
b. PIGA Calibration Tests			
c. Platform Servo Tests			
d. Pre-Arm Tests			
e. Accelerometer Gate Tests			
f. Cut-off Tests			
g. Flight Control Loop Tests			
19. F/C System Tests			
a. Set-up Check			
b. Set-up Check Marginal Test			
c. Erection Test			
d. Digital Maintenance Test			
20. Test Set Mk 352 Mod 0			

FORM IFI
SERIAL

PART III-C - BASIC PROFICIENCY REQUIREMENTS FOR MT's

PROFICIENCY AREAS	Operate	Preventive Maintenance	Corrective Maintenance
1. Physical Characteristics of Missile			
a. 1st stage motor			
b. Inter-stage section			
c. 2nd stage motor			
d. Equipment section			
e. Re-entry body			
2. Functions of the Subsystems			
a. Propulsion subsystem			
b. Guidance subsystem			
c. Flight control subsystem			
d. Electrical subsystem			
e. Re-entry body			
3. Electrical Subsystem			
a. Interlocks I			
b. Interlocks II			
4. Ignition Systems			
5. Initiator Circuit NO-Voltage Test Set			
6. Igniter Installation			
7. Guidance Computer Terminology			
8. IRIG's			
9. PIGA's			
10. Platform stabilization			
a. Stabilization loops			
b. Drive system			
11. PIGA Servo Electronics			
12. Flight Control Subsystem			
a. Rate Gyro Package			
b. Electronic Package			
c. Hydraulic Package			

PROFICIENCY AREAS	Operate	Preventive Maintenance	Corrective Maintenance
13. Computer Mk 3 Mod 1			
14. Platform Test Set Mk 390			
15. Pre-Arm (IFS) Circuit in Mk 3 Mod 1 G/C			
16. Telemetry in Mk 3 Mod 1 G/C			
17. Mk 1 Guidance Power Supplies			
18. Mk 387 Mod 0 Computer Test Set			
19. Computer Test Set Logic			
20. Power Supply Test Set Mk 389 Mod 0			
21. Guidance Computer Programming			
22. Mk 115 Mod 1 GPSU			
23. Mk 1 Mod 0 Computer Blueprint Reading			
24. MTRE/DUE/MISSILE Testing			
25. Digital Differential Analyzer			

FORM IFI
SERIAL

FLEET INTERVIEW SCHEDULE
PART IV - TEST EQUIPMENT REQUIREMENTS

Conducted by
Dunlap and Associates, Inc.
425 13th Street, N. W.
Washington 4, D. C.

INSTRUCTIONS

The following is a list of the test equipment used in the FBM Weapon System. On the basis of what you do in your present assignment, check those equipments you use. If any item of test equipment you have available and use is not included, write it in the space provided at the end of the list. If you wish to make comments, place an asterisk (*) after your check mark, turn to the third page, identify the equipment on which you are commenting, and write your remark.

FORM IFI

Supervisor's Instructions for Rating of Skill Levels in Use of Test Equipment

Rate recent school graduates on their skill in using test equipment according to the following scale:

1 **Has only a limited knowledge of the use of this equipment. Has not actually used it in maintenance tasks.**

2 **Has a complete briefing on the equipment. Can use equipment only if assisted in every step of the operation. Requires much more training in the use of equipment and interpretation of results.**

3 **Understands the equipment. Has applied this understanding either on the actual job or a trainer. Can do the job if closely supervised on the more difficult parts.**

4 **Understands the equipment and has used it enough times to attain confidence in its use. Needs more practice under limited supervision.**

5 **Has full competence in the use of the equipment. Can operate equipment without supervision.**

6 **Has full competence in the use of the equipment. Can modify test procedures to fit task at hand.**

FORM IFI
SERIAL

TEST EQUIPMENT REQUIREMENTS

EQUIPMENT	(✓) If you Repair	Equipment used in Maintenance		(✓) Where Training Was Received				Supervisor's Rating of Recent School Graduates					
		Prevent.	Correct	School A	School C	On Job	Other	1	2	3	4	5	6
1. Scope - Tektronic 545A													
2. Preamp - Tektronic Type CA													
3. Preamp - Tektronic Type M													
4. Scope - Tektronic 310													
5. VTVM - HP400													
6. Pulse Counter - Beckman 7360													
7. Multimeter - Simpson 269													
88. Voltmeter - Weston 931													
9. Phase Sensitive Vacuum Tube VM- North Atlantic VM 204													
10. LACE Test Equipment Module Tester Mk 380 Mod 0 Tactical Calibration Maint. Set Mk 379 Mod 0													
11. ULCER Test Equipment Module Tester Mk 382 Mod 0 Tactical Calibration Maint. Set													
12. Test Set (MATS) Mk 352 Mod 0													
13. Test Set (MOTS) Mk 412													
14. Simulator, Guidance Mk 11 Mod 0													
15. Platform Test Mk 390 Mod 1													
16. Computer Test Set Mk 387 Mod 1													
17. Power Supply Test Set Mk 389 Mod 1													

COMMENTS ON TEST EQUIPMENT

FORM IFI
SERIAL

FLEET INTERVIEW SCHEDULE
PART V - MAINTENANCE REQUIREMENTS

Conducted by
Dunlap and Associates, Inc.
425 13th Street, N. W.
Washington 4, D. C.

INSTRUCTIONS

For the equipment items listed, check (✓) the most detailed level of corrective maintenance performed.

FORM IFI
SERIAL

PART V - MAINTENANCE REQUIREMENTS

EQUIPMENT	CORRECTIVE MAINTENANCE		
	Assembly Replace-ment	Module Replace-ment	Piece Part[1] Replace-ment
1. Computer Group Mk 123, Mod 0/1 (Erection Unit)			
2. Computer Group Mk 124 Mod 0 (Tgt Data Input Unit)			
3. Patch Panel			
4. Computer Grp Mk 125 Mod 0 (MMU)			
5. Computer Group Mk 126 Mod 0			
a. Alignment Units			
b. Ships Pos. Interpol. Unit			
6. Switching Unit			
7. Computer Group Mk 127 Mod 0			
a. Digital Input Unit			
b. Digital Evaluation Unit			
c. Digital Monitor Unit			
8. Control Console Mk 49 Mod 0			
9. Power Supply Group Mk 117/118 Mod 0 (PSU 1, 2, 3, & 4)			
10. Indicator Panel Mk 225 Mod 0			
11. Input Panel Mk 224 Mod 1			
12. P. S. Mk 115/116, Mod 0			
13. Nav. Data Simulator Mk 8 Mod 0			
14. Alignment Group Mk 1 Mod 0			
a. Alignment Trolley Mk 1, Mod 0/1			
b. Alignment Track Ass'y Mk 1			
c. Align. Drive Ass'y Mk 1, Mod 0/1			
d. Align. Collim. Ass'y Mk 18, Mod 0			
e. Align. Control Pnl. Mk 238, Mod 0			
f. Align. Peris. Mk 52, Mod 0			
g. Align. Pentameter Mk 1 Mod 0			
h. Cable Reel Mk 3 Mod 0			
15. Test Set Mk 352 Mod 0 (MATS)			
16. Patch Panel Mk 226, Mod 0			
17. Fuze Set Amp. Mk 157 Mod 0			
18. Patch Panel Mk 227, Mod 1			
19. Datico Type C/MTRE Mk 3			
a. Basic Section			
b. Service unit section			
c. Monitoring and Display section			

[1] In some interviews, interface was substituted for Assembly Replacement.

EQUIPMENT	CORRECTIVE MAINTENANCE		
	Assembly Replacement	Module Replacement	Piece Part Replacement
20. Missile Launcher Control Group MK 11 Mod 0			
a. Launch Angle Cond. Eval. Mk 11			
b. ULCER MK 11 Mod 0			
21. Polaris Missile Mk 1 Mod 0			
a. Propulsion Systems			
1. 1st Stage Rocket Motor			
2. 2nd Stage Rocket Motor			
3. Jetevators			
4. Thrust Termination Ports			
b. Equip. Sect. Mk 1 Mod 0 and Interstage Sect. Mk 1 Mod 0			
c. Flight Control System			
1. Electronics Package			
2. Gyro Package			
d. Re-entry Body Mk 1 Mod 0			
e. Guidance System Mk 1			

COMMENTS:

VI. General Interview Questions[1/]

A. Operation

1. Go over the checklists and discuss any significant difficulties in the operational procedures associated with equipment you have manned.

2. From your own point of view, discuss any additional on-the-job training, team training, and Dam Neck training that would make it easier to perform your operator duties.

[1/] After the first fleet interviews, Part B. 1 and 2, Preventive Maintenance, and Part C. 1 and 2, Corrective Maintenance, were combined with Part A. 1 and 2 to make a single category: Operation and Maintenance. In addition, question A. 3. was changed to read: "What do you do during a typical 2SQ watch?"

3. What portion of your watch is spent operating equipment?

4SQ _____%
3SQ _____%
2SQ _____%
1SQ _____%

B. Preventive Maintenance

1. Go over the checklists again and discuss any significant difficulties in the preventive maintenance procedures associated with equipment you have worked on.

2. From your own point of view, discuss any additional on-the-job training, team training, and Dam Neck training that would make it easier to perform your preventive maintenance duties.

3. What portion of your watch is spent in preventive maintenance?

4SQ _____%
3SQ _____%
2SQ _____%
1SQ _____%

C. Corrective Maintenance

1. Using the checklist, discuss any significant difficulties in the corrective maintenance procedures associated with equipment you have worked on.

2. From your own point of view, discuss any additional on-the-job training, team training, and Dam Neck training that would make it easier to perform your corrective maintenance duties.

3. What portion of your watch is spent performing corrective maintenance on the equipment you maintain?

4SQ_____%
3SQ_____%
2SQ_____%
1SQ_____%

D. What technical areas do you study to "keep-up" with your job? (Don't include advancement in rate materials)[1/]

E. In addition to your formal training at the factory and/or at Dam Neck, how much training have you received on:

1. Shipboard trainer _____ _____
hrs. per week no. of weeks

2. New London Team Trainer _____ _____
hrs. per week no. of weeks

1/ On some interviews this question was changed to: "Go over checklist and circle the areas in which you had to do further study in order to do your job."

F. Do you have any other comments you wish to make?

FINAL FLEET INTERVIEW

FORM FFI

FORM FFI
SERIAL _____

FBM INTERVIEW SCHEDULE

Conducted by
Dunlap and Associates, Inc.
425 13th Street, N. W.
Washington 4, D. C.

Part I - BACKGROUND INFORMATION[1]

Name _____ Rate _____ Age ____

Present Assignment _____
(NOTE: Instructors should indicate course(s) they are instructing)

Previous job assignments while in Polaris Program. Include FBM training in Special Technology, Mk 80 or Mk 84 Fire Control, GS "C" 1 or GS "C" 2, refresher training at New London and patrol experience:

	Assignment	Approx. start	Approx. finish	Location
1.				
2.				
3.				
4.				
5.				

CIVILIAN TRAINING AND EXPERIENCE

Training: (Circle level attained)

High School: 1 2 3 4; College: 1 2 3 4

Civilian Technical School (e.g., correspondence course, electronics (9 mos.))

a. _____ ( )
b. _____ ( )
c. _____ ( )

Related civilian experience: (enter months in parentheses after each job)

a. _____ ( )
b. _____ ( )
c. _____ ( )

[1] This information was not requested of Weapons and Assistant Weapons Officers. It was requested only of supervisors and trainees

MILITARY TRAINING AND EXPERIENCE

Other systems training and experience related to Polaris programs: (enter months in parentheses provided)

Type_____( ) Type_____( )
Type_____( ) Type_____( )
Type_____( ) Type_____( )

"A" School ( ); "B" School ( ); Length of time in Service _____ / _____
(Enter months of school in parentheses) yrs. mos.

DETAILED DUTY DESCRIPTION[1]

Name_____ Duty Title_____

1. Description of duties during typical patrol watch (describe in detail the tasks performed and the equipment operated and/or maintained during a typical watch):

[1] Requested of supervisors and trainees

2. a. Identify the duties you perform that are not included in your Navy Enlisted Classification (NEC) number.

b. What on-the-job training did you receive in the duties normally performed by other personnel?

3. a. What do you consider to be the greatest weakness in the training you received at Dam Neck?

b. Identify the most useful training for present assignment.

(1) Type

(a) Why was it most useful?

(2) Type

(a) Why was it most useful?

(3) Type

(a) Why was it most useful?

(4) Type

(a) Why was it most useful?

4. List the typical sequence of events that occurs upon observation of an equipment casualty. Include both administrative and technical procedures followed in repairing the casualty.

a. _____
b. _____
c. _____
d. _____
e. _____
f. _____
g. _____
h. _____
i. _____
j. _____

5. Do interface malfunctions occur that are difficult to isolate?

SUPERVISOR QUESTIONS[1]

1. How is the Weapons Department organized on your ship? (WO only)

Rating	Reports to	Assigned to (equipment)

2. What is the typical sequence of training events that occurs in the shipboard training of Dam Neck trainees starting from the day they come aboard until they are completely trained. Discuss why operators are assigned to particular equipments.

[1]Requested of WO's, AWO's and Supervisors

3. In terms of fleet requirements, what, if any, are the most significant deficiencies/strengths in trainees coming from Dam Neck?

4. What, in your opinion, should be the objective of Dam Neck training?

TOPIC [1]

Strengths [2]	Weaknesses [3]	? [4]

1. Normal operation of equipment
2. Interpretation of front panel indications using appropriate OP's in malfunction analysis
3. Reading and analysis of block diagrams
4. Reading and analysis of logic prints
5. Reading and analysis of circuit diagrams
6. Ability to use oscilloscope and meters in input-output analysis
7. Ability to physically locate and substitute defective circuit boards
8. Use of oscilloscope and meters for static and dynamic checking of circuits to the piece/part level
9. Use of special test equipment (such as MATS or MOTS) and associated instructions
10. Ability to repair printed circuits

---

[1] Ratings of recent Guided Missile School graduates requested of WO's, AWO's, and supervisors

[2] Definition of strength is: Understands the subject or task to be done; can do the job if closely supervised on the more difficult parts. Base your evaluation on the average trainee's performance the first time he is called upon to demonstrate proficiency in the above areas

[3] Definition of weakness: Opposite of strength

[4] Definition of (?): Cannot judge proficiency in this area

RATINGS OF SKILL AND KNOWLEDGE REQUIREMENTS[1]

INSTRUCTIONS

Trainees have received intensive instruction in each of the following areas. Evaluate your/his proficiency in these areas prior to shipboard on-the-job training and experience. Use the following criterion:

HAD AN ADEQUATE THEORETICAL AND PRACTICAL KNOWLEDGE OF THIS AREA PRIOR TO ANY SHIPBOARD TRAINING OR EXPERIENCE

If you feel that you are not qualified to evaluate proficiency, place a check mark in the (?) space.

[1] Requested of supervisors and trainees

FORM FFI
FT-IA

SAMPLE SKILL AND KNOWLEDGE REQUIREMENT SHEET[1]

Mk 80 FT Topic - Computer Group Mk 123, Mod 0/1 (Erection Unit)[2]

1. Has criterion been met? Yes___; No___; (?)___. No training or experience required___.

2. If criterion has been met, could less time have been spent on this topic at Dam Neck? Yes___; No___; (?)___. If yes, should less time be spent on: primarily practical___, primarily theorectical___, both practical and theoretical___training?

3. If more training is required to meet criterion, what effect does this lack of training have on the performance of specific tasks?

4. To overcome this weakness, should additional Dam Neck training be: primarily practical___, primarily theoretical___, both practical and theoretical___.

5. Was additional introductory-type training on this topic provided after Dam Neck? Yes___; No___. If yes, indicate whether it included any of the following: special lectures___, practical demonstrations___, homework or problem assignments___. How many additional hours were provided___?

6. Upon the completion of Dam Neck training, how much OJT was required for a complete understanding of the subject or task, such that no further supervision or study was required?

7. Comment:

---

[1] Question 6 was generally deleted in fleet interviews with supervisors and trainees. Question 2 was deleted in fleet interviews with supervisors who were not recent GMS graduates.

[2] Lists of the topics that were employed are presented in the following pages.

MARK 84 FT

Skill and Knowledge Requirements List

Topic No.	Topic Title
FT-1	Digital modules
FT-2	Analog modules
FT-3	Power supply modules
FT-4	Power distribution subsystem
FT-5	MCC cooling: temperature sensing module
FT-6	Switches
FT-7	Patches
FT-8	Master clock and timing subsystem
FT-9	Timing terminology
FT-10	Master timer assembly (MTA)
FT-11	Timing generators
FT-12	Guidance computer timing
FT-13	Alignment subsystem
FT-14	Missile motion computers
FT-15	Erection subsystem
FT-16	Gimbal angle matching monitor (GAMM)
FT-17	Digital read-in subsystem (DRISS): missile driver assembly (MDA)
FT-18	Digital read-in subsystem (DRISS): digital read-in assembly (DRA)
FT-19	Launch sequence control
FT-20	Mk 133 Mod 0 TRAMP unit: gimbal angle runaway detector (GARD)
FT-21	Temperature control portion of TRAMP
FT-22	F/C ACP indication and launch command interface logic
FT-23	ULCER II, LCP and IMP interface logic with the F/C equipment
FT-24	F/C print format
FT-25	F/C printer logic
FT-26	Training alarm controller (TAC)
FT-27	F/C training simulators
FT-28	ITOP: F/C test
FT-29	ITOP: missile test
FT-30	Fuze set subsystem
FT-31	MTRE Mk 6
FT-32	MTRE Mk 7

Topic No.	Topic Title
FT-33	MOTS Mk 412 Mod 0
FT-34	Swbd. barrel switches
FT-35	Logs, reports and TFRs
FT-36	Safety rules
FT-37	IMP and LCP
FT-38	Navigation system
FT-39	Nav/FC/Optical alignment interface
FT-40	MCC power distribution - ship's power
FT-41	Multi-Speed Repeaters

MARK 80 FT

Skill and Knowledge Requirements List

Topic No.	Topic Title
FT-1A	Computer group Mk 123 Mod 0/1 (erection unit)
FT-2A	Computer group Mk 124 Mod 0 (tgt data input unit)
FT-3A	Computer group Mk 125 Mod 0 (MMU)
FT-4A	Computer group Mk 126 Mod 0: alignment units
FT-5A	Computer group Mk 126 Mod 0: ships pos. interpol unit
FT-6A	Computer group Mk 127 Mod 0: digital input unit
FT-7A	Computer group Mk 127 Mod 0: digital evaluation unit
FT-8A	Computer group Mk 127 Mod 0: digital monitor unit
FT-9A	Control console Mk 49 Mod 0
FT-10A	Indicator panel Mk 225 Mod 0 (ACP)
FT-11A	Nav. data simulator Mk 8 Mod 0
FT-12A	Alignment group Mk 1 Mod 0
FT-13A	Fuze set amp. Mk 157 Mod 0
FT-14A	Datico type C/MTRE Mk 3
FT-15A	F/C terminology
FT-16A	800-cycle reference generator
FT-17A	Digital erase and read-in (erase Gen. in E.U.)
FT-18A	Timing relationship between F.C. and guidance computer
FT-19A	Analog computations
FT-20A	Servo module
FT-21A	Torque amplifier
FT-22A	Earth's rate frequency generator
FT-23A	Digital to analog converter
FT-24A	Reverse counter
FT-25A	Guidance power supply Mk 115 Mod 1
FT-26A	Middle and outer gimbal drive
FT-27A	Decoding and pulse selection (PIGA decode)
FT-28A	Events counter operation
FT-29A	Timing - interval indicator
FT-30A	Missile F/C tests: missile clock test
FT-31A	Missile F/C tests: PIGA calibration tests
FT-32A	Missile F/C tests: platform servo tests
FT-33A	Missile F/C tests: pre-arm tests
FT-34A	Missile F/C tests: accelerometer gate
FT-35A	Missile F/C tests: cut-off tests
FT-36A	Missile F/C tests: flight control loop tests

Topic No.	Topic Title
FT-37A	F/C system tests: set-up check
FT-38A	F/C system tests: set-up check marginal test
FT-39A	F/C system tests: erection test
FT-40A	F/C system tests: digital maintenance test
FT-41A	Test set Mk 352 Mod 0 (MATS)
FT-42A	Navigation system
FT-43A	Multispeed repeaters
FT-44A	Nav/FC/Optical alignment interface
FT-45A	Symmetry test set
FT-46A	MTRE Op mode verifier
FT-47A	MCC power distribution - ships power
FT-48A	ULCER/ship interface
FT-49A	LOP and LPP
FT-50A	Guidance and power supplies
FT-51A	Swbd barrel switches
FT-52A	Signals through each switch (functions)
FT-53A	Logs, reports and TFRs
FT-54A	Safety rules

598/608 and 616 MT

Skill and Knowledge Requirements List

Topic No.	Topic Title
MT-1	Physical Characteristics of Missile: 1st stage motor
MT-2	Physical Characteristics of Missile: Inter-stage section
MT-3	Physical Characteristics of Missile: 2nd stage motor
MT-4	Equipment section
MT-5	Re-entry body
MT-6	Functions of the Subsystems: Propulsion subsystem
MT-7	Functions of the Subsystems: Guidance subsystem
MT-8	Functions of the Subsystems: Flight control subsystem
MT-9	Functions of the Subsystems: Electrical subsystem
MT-10	Functions of the Subsystems: Re-entry body
MT-11	Electrical Subsystem: Interlocks I
MT-12	Electrical Subsystem: Interlocks II
MT-13	Ignition Systems
MT-14	Guidance Computer Terminology
MT-15	IRIG's
MT-16	PIGA's
MT-17	Platform stabilization
MT-18	PIGA servo electronics
MT-19	Flight Control Subsystem: Rate gyro package
MT-20	Flight Control Subsystem: Electronic package
MT-21	Flight Control Subsystem: Hydraulic package
MT-22	Computer Mk 3 Mod 1
MT-23	Platform test set Mk 390
MT-24	Pre-arm (IFS) circuit in Mk 3 Mod 1 G/C
MT-25	Telemetry in Mk 3 Mod 1 G/C
MT-26	Mk 1 Guidance power supplies
MT-27	Mk 387 Mod 0 computer test set
MT-28	Computer test set logic
MT-29	Power supply test set Mk 389 Mod
MT-30	Guidance computer programming
MT-31	Mk 115 Mod 1 GPSU
MT-32	Mk 1 Mod 0 Computer
MT-33	MTRE/DEU/MISSILE testing
MT-34	MTRE watch mode
MT-35	MTRE Op mode verifier
MT-36	MCC power distribution - ships power
MT-37	ULCER/ship interface

Topic No.	Topic Title
MT-38	LOP and LPP
MT-39	Guidance power supplies
MT-40	Swbd barrel switches
MT-41	Signals through each switch (functions)
MT-42	Logs, reports and TFR's
MT-43	Safety rules
MT-44	Digital evaluation unit
MT-45	FC console
MT-46	MTRE tape preparation unit
MT-47	Alignment loops
MT-48	Erection loops
MT-49	Digital loops
MT-50	Set-up tests
MT-51	MCC power
MT-52	ULCER and ULCER recorder
MT-53	Optical alignment
MT-54	Launcher tube system
MT-55	Launcher tube hydraulic system
MT-56	IC
MT-57	On-loading missiles
MT-58	Blueprint reading
MT-59	Test set Mk 352 Mod 0 (MATS) or Mk 412 (MOTS)
MT-60	Digital differential analyzer

INITIAL INSTRUCTOR INTERVIEW

FORM I. I. I.

FORM I.I.I.
SERIAL _____

DAM NECK INSTRUCTOR'S INTERVIEW SCHEDULE

Conducted by
Dunlap and Associates, Inc.
425 13th Street, N. W.
Washington 4, D. C.

Part I - BACKGROUND INFORMATION

Name _____ Rate _____ Age ___ Length of time in Service _____ / _____
yrs. mos.

Present Assignment _____
(indicate course(s) you are instructing)

CIVILIAN TRAINING AND EXPERIENCE

Training: (Circle level attained)

High School: 1 2 3 4; College: 1 2 3 4

Civilian Technical School (enter months studied after each topic)

a. _____ ( )
b. _____ ( )
c. _____ ( )

Related Civilian Experience: (enter months of experience in parentheses after each job)

a. _____ ( )
b. _____ ( )
c. _____ ( )

MILITARY TRAINING AND EXPERIENCE

Training: (Enter length of school in parentheses)

"A" School ( ); "B" School ( ); Special Tech. Course _____ / _____ / _____
when how long where

FBM System Course _____ / _____ / _____ Team Training (NL) ( )
when how long where

Experience:

Ship_____ No. Patrols_____ Crew: Blue_____ Gold_____
(If you have had patrol experience, indicate above)

Other systems and/or other related experience: (enter months of experience in parentheses provided)

Type_____( ) Type_____( )

Type_____( ) Type_____( )

Type_____( ) Type_____( )

Job assignments (e.g., while in Polaris Program): (Chronological order

Assignment	Months	Where training was received (percent) School	On Job
1. _____	( )	( )	( )
2. _____	( )	( )	( )
3. _____	( )	( )	( )
4. _____	( )	( )	( )
5. _____	( )	( )	( )

INSTRUCTIONS

Two Mark 80 FT and two 598/608 MT senior instructors were asked to rate what the average trainee needs and what he gets in the way of training at the Guided Missile School. The following scale was used:

SCALE FOR RATING FBM PROFICIENCY REQUIREMENTS

0 - Both theoretical and practical knowledge of this area are nice to know but are not needed to perform duties (don't get)

1 - Primarily practical knowledge of this area needed (gets)

2 - Primarily theoretical knowledge of this area needed (gets)

3 - Thorough practical and theoretical knowledge needed (gets)

Name _____ FORM I. I. I.
SERIAL _____

PART II - SPECIAL KNOWLEDGE REQUIREMENTS

Knowledge Category	Requirement "Needs"	"Gets"
TRANSISTORS		
1. Semi-conductors		
2. H parameters		
3. Transistor biasing		
4. Common transistor circuits		
PRINTED CIRCUITS		
1. Mfg. of printed circuit boards		
DIGITAL COMPUTING		
1. Numbering systems		
2. Binary math processes		
3. Conversion between numbering systems		
4. Boolean algebra and basic laws of logic		
5. Veitch diagrams		
6. Logic diagrams (functional)		
7. Switching circuits		
8. Timing circuits		
9. Shift registers		
10. Adders and subtractors		
11. Computer control circuits		
12. Jump shift circuits		
13. Magnetic theory		
a. Magnetic amplifiers		
b. Magnetic cores (in computer memory)		
14. Resolvers		
a. Inductosyns (pick-off devices)		
b. Multi-speed loop converters		
15. Integrators, differentiators and operational amplifiers		
16. Storage devices		
17. Drum-type computer		
18. Programming		
19. Analog-digital converters		
20. Digital-analog converters		

Knowledge Category	Requirement "Needs"	"Gets"
INERTIAL PHYSICS		
1. Corioles' Effect		
2. Newton's Laws		
3. Vector Analysis: Forces, Displacement, Velocity, Acceleration		
4. Gyro's		
a. Precession		
b. Torque		
5. Accelerometers		
SERVO-LOOP FUNDAMENTALS		
1. Operation and application of servo-mechanisms		
2. Schular tuned loops		
3. 3 & 4 Gimbal systems		
MISCELLANEOUS		
1. Comparators		
2. Differentiators		
3. Two-wire encoder		
4. Symmetry		

COMMENTS:

NAME _____ FORM I.I.I.
SERIAL _____

PART III - BASIC PROFICIENCY REQUIREMENTS
(Section I)

PROFICIENCY AREAS	Requirement "Needs"	"Gets"
1. Physical Characteristics of Missile		
a. 1st stage motor		
b. Inter-stage section		
c. 2nd stage motor		
d. Equipment section		
e. Re-entry body		
2. Functions of the Subsystems		
a. Propulsion subsystem		
b. Guidance subsystem		
c. Flight control subsystem		
d. Electrical subsystem		
e. Re-entry body		
3. Electrical Subsystem		
a. Interlocks I		
b. Interlocks II		
4. Ignition Systems		
5. Initiator Circuit NO-Voltage Test Set		
6. Igniter Installation		
7. Guidance Computer Terminology		
8. IRIG's		
9. PIGA's		
10. Platform Stabilization		
a. Stabilization loops		
b. Drive system		
11. PIGA Servo Electronics		
12. Flight Control Subsystem		
a. Rate Gyro Package		
b. Electronic Package		
c. Hydraulic Package		

PROFICIENCY AREAS	Requirement "Needs"	"Gets"
13. Computer Mk 3 Mod 1		
14. Platform Test Set Mk 390		
15. Pre-Arm (IFS) Circuit in Mk 3 Mod 1 G/C		
16. Telemetry in Mk 3 Mod 1 G/C		
17. Mk 1 Guidance Power Supplies		
18. Mk 387 Mod 0 Computer Test Set		
19. Computer Test Set Logic		
20. Power Supply Test Set Mk 389 Mod		
21. Guidance Computer Programming		
22. Mk 115 Mod 1 GPSU		
23. Mk 1 Mod 0 Computer		
24. MTRE/DEU/MISSILE Testing		
25. MTRE Watch Mode		
26. MTRE Op Mode Verifier		
27. MCC Power Distribution - Ship's Power		
28. ULCER/Ship Interface		
29. LOP and LPP		
30. Guidance Power Supplies		
31. Swbd. Barrel Switches		
32. Signals through each switch (functions)		
33. Logs, Reports and TFRs		
34. Safety Rules		
35. Erection Unit		
36. FC Console		
37. MTRE Tape Preparation Unit		
38. Alignment Loops		
39. Erection Loops		
40. Digital Loops		
41. Set-Up Tests		
42. MCC Power		
43. ULCER and ULCER Recorder		
44. Optical Alignment		
45. Launcher Tube System		
46. Launcher Tube Hydraulic System		
47. IC		
48. On-Loading Missiles		
49. Blueprint Reading Schematics		
50. Test Set Mk 352 Mod 0 (MATS) or Mk 412 (MOTS)		
51. Digital Differential Analyzer		

NAME _____ FORM I.I.I.
SERIAL _____

PART III - BASIC PROFICIENCY REQUIREMENTS
(Section II)

PROFICIENCY AREAS	Requirement "Needs"	"Gets"
1. Computer Group Mk 123, Mod 0/1 (Erection Unit)		
2. Computer Group Mk 124, Mod 0 (Tgt Data Input Unit)		
3. Computer Group Mk 125 Mod 0 (MMU)		
4. Computer Group Mk 126 Mod 0		
a. Alignment Units		
b. Ships Pos. Interpol Unit		
5. Computer Group Mk 127 Mod 0		
a. Digital Input Unit		
b. Digital Evaluation Unit		
c. Digital Monitor Unit		
6. Control Console Mk 49 Mod 0		
7. Indicator Panel Mk 225 Mod 0 (ACP)		
8. Nav. Data Simulator Mk 8 Mod 0		
9. Alignment Group Mk 1 Mod 0		
10. Fuze Set Amp. Mk 157 Mod 0		
11. Datico Type C/MTRE Mk 3		
a. Basic Section		
b. Service unit section		
c. Monitoring and Display section		
12. F/C Terminology		
13. 800-Cycle Reference Generator		
14. Digital Erase and Read-In (erase Gen. in E.U.)		
15. Timing relationship between F.C. and Guidance Computer		
16. Analog Computations		
17. Servo Module		
18. Torque Amplifier		
19. Earth's Rate Frequency Generator		
20. Digital to Analog Converter		
21. Reverse Counter		
22. Guidance Power Supply Mk 115 Mod 1		
23. Middle and Outer Gimbal Drive		
24. Decoding and Pulse Selection (PIGA decode)		
25. Events Counter Operation		
26. Timing - Interval Indicator		

PROFICIENCY AREAS	Requirement "Needs"	"Gets"
27. Missile F/C Tests		
a. Missile Clock Test		
b. PIGA Calibration Tests		
c. Platform Servo Tests		
d. Pre-Arm Tests		
e. Accelerometer Gate		
f. Cut-off Tests		
g. Flight Control Loop Tests		
28. F/C System Tests		
a. Set-up Check		
b. Set-up Check Marginal Test		
c. Erection Test		
d. Digital Maintenance Test		
29. Test Set Mk 352 Mod 0 (MATS)		
30. Navigation System		
31. Multispeed Repeaters		
32. Nav/FC/Optical Alignment Interface		
33. Symmetry Test Set		
34. MTRE Op Mode Verifier		
35. MCC Power Distribution - Ship's Power		
36. ULCER/Ship Interface		
37. LOP and OPP		
38. Guidance and Power Supplies		
39. Swbd. Barrel Switches		
40. Signals through each switch (functions)		
41. Logs, Reports and TFRs		
42. Safety Rules		

NAME _____ FORM I. I. I.
SERIAL _____

TEST EQUIPMENT REQUIREMENTS

EQUIPMENT	Requirement "Needs"	"Gets"
1. Scope - Tektronic 545A		
2. Preamp - Tektronic Type CA		
3. Preamp - Tektronic Type M		
4. Scope - Tektronic 310		
5. VTVM - HP400		
6. Pulse Counter - Beckman 7360		
7. Multimeter - Simpson 269		
8. Voltmeter - Weston 931		
9. Phase Sensitive Vacuum Tube VM - North Atlantic		
VM 204		
10. LACE Test Equipment		
a. Module Tester Mk 380 Mod 0		
b. Tactical Calibration Maintenance Set Mk 379 Mod 0		
11. ULCER Test Equipment		
a. Module Tester Mk 382 Mod 0		
b. Tactical Calibration Maintenance Set		
12. Test Set (MATS) Mk 352 Mod 0		
13. Simulator, Guidance Mk 11 Mod 0		
14. Platform Test Mk 390 Mod 1		
15. Computer Test Set Mk 387 Mod 1		
16. Power Supply Test Set Mk 389 Mod 1		

APPENDIX B

CONTACT LIST

APPENDIX B

CONTACT LIST

Bureau of Naval Personnel

Pers 15
CAPT R. J. Baxter

Pers 153
Mr. A. Sjoholm
Mr. E. Ramras

New Developments Research Dept. (PRAW)
Mr. J. Donnelly
Mr. J. Kinney
Mr. R. Madle

Pers C231
CDR G. Wolfe
CDR J. Snyder, Jr.
LCDR D. Murray

Pers C114
LT B. Higgins

Pers C14
Mr. M. Callahan
Mr. R. Bath
Mr. R. Deakin

Bureau of Naval Weapons, Special Projects Office

SP 112	CDR M. Christensen
SP 2013	CDR J. Bailey
SP 2015	Mr. D. Cain
SP 2017	Mr. C. Evans

Office of Naval Research

Dr. G. Bryan
Mr. J. Nagay

General Electric Ordnance Department

Mr. R. Trefny (Prod. Tng.)
Mr. A. Whiton (Prod. Tng.)
Mr. P. Williams (Prod. Plan.)
LCDR W. Olson (SPG)
Mr. G. Burkholder (Human Factors)
Mr. J. Rusk (Sys. Eng.)

Guided Missiles School, Dam Neck, Virginia Beach, Virginia

CDR F. Brtek
CDR C. Cushman, Jr.
LT J. L. deGroff
LT J. Coolidge
(relieved LT J. L. deGroff)
LTJG W. Ashley
LT S. Morris
(relieved LTJG W. Ashley)
LT V. Bacon
LT P. Fornier
LT R. D'Antonio

Chief G. Thomason, Chief Kennedy, and 63 other instructors at GMS

Lockheed Aircraft Corporation, Sunnyvale, Calif.

Mr. Stanley W. Harbourt (Prod. Tng.)

U. S. N. Submarine Base, New London, Connecticut

CDR J. Lindsay (SubRon 14 Training Officer)
LCDR J. O'Kane (SubRon 16 Personnel Officer)
LT J. Fox (Refresher Training Officer)
LT J. Levy (Refresher Training Officer)

GEORGE WASHINGTON, SSB(N) 598
LT J. Delaney (AWO, Gold)

PATRICK HENRY, SSB(N) 599
LT A. Moreau (WO, Gold)
LT D. Ulner (WO, Blue)

THEODORE ROOSEVELT, SSB(N) 600
LCDR R. Arison (WO, Gold)
LT P. Miller (AWO, Gold)

ROBERT E. LEE, SSB(N) 601
LCDR W. Bohannan (WO, Blue)
LT G. Scott (AWO, Blue)

ABRAHAM LINCOLN, SSB(N) 602
LT M. Wallander (AWO, Gold)

THOMAS A. EDISON, SSB(N) 610
LCDR J. McCune (WO, Gold)
LCDR T. Cagney (WO, Blue)
LT J. Fletcher (AWO, Blue)

LAFAYETTE, SSB(N) 616
LT D. Lawrence (WO, Blue)
LT D. West (AWO, Blue)

ALEXANDER HAMILTON, SSB(N) 617
LT D. Harriss (WO, Blue)

(And 61 MTs, FTs, and FTMs from the above ships)

APPENDIX C

REFERENCES

APPENDIX C

REFERENCES

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